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ERTS - 1 IMAGERY INTERPRETATION TECHNIQUES IN THE TENNESSEE VALLEY

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16. Abstract

Significant findings are presented which demonstrate the feasibility of delineating major terrain features, land uses, and crop species through computerized analyses. Delineation of features are presently restricted to unsurveyed areas within the same scene as the test sites. Channel 6 appears to give or contain the most information for making feature separations of cropland, pasture, forest and water.

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Preface

The purpose of this report is to summarize the research activity concerned with image processing and interpretation techniques in the Tennessee Valley. In addition to providing the capability of "on-line" image processing for ERTS Investigators at the University of Tennessee during this report period, efforts in bulk processing have resulted in demonstrating the feasibility of delineating major terrain features, land uses, and crop species through computer analyses. By enlarging satellite imagery and visually comparing this with high-altitude aerial photography and computer printouts, data registration of small terrain features and cropland areas on satellite imagery is greatly facilitated.

LIST OF TABLES

INTRODUCTION

The purpose of this report is to summarize the second six months of research activity on proposal MMC # 162-06 (NAS5-21875), "ERTS - 1 Imagery Interpretation Techniques in the Tennessee Valley", during the period from March 25, 1973 to September 25, 1973. A significant achievement has been the demonstration of the feasibility of delineating major terrain features, land uses, and crop species through computerized analyses. For making separations of this type Channel 6 appears to give the most information. In addition, the status of the "on-line" image processing system for ERTS Investigators at the University of Tennessee is described.

MAIN TEXT

Background. The research activity of this group (MMC # 162-06) is to provide data analysis support for ERTS investigations in several other disciplines at the University of Tennessee. Each of the other groups (agriculture, geography, and ecology) supported by the ERTS-1 program are generally interested in different studies and different features of the data. The projected goal for this support is to coordinate the efforts in data management and data analysis between the disciplines and to aid each individual in the development and modification of analysis techniques for the maximum utilization of ERTS data.

Summarized Progress. Continued effort in Phase III of this research has resulted in the following description of significant findings.

"Soil Moisture Evaluation and Land Uses
From ERTS-1 Imagery" - UN650,UN654

Locating small cropland areas and correlating aerial photos of these areas with prints of satellite imagery has been difficult. This problem has been resolved by using enlargements of satellite imagery and carefully examining the various color shades of the satellite imagery with aerial photos and computer printouts of the satellite imagery. Due to cloud cover, haze, and similar related problems, only about one image of four is sufficiently clear to use for comparison purposes. This has created a time differential resulting in comparison problems since drastic changes in crop maturity, soil moisture, and soil temperature have sometimes occurred.

Two primary West Tennessee target sites, the West Tennessee Experiment Station and the Ames Plantation, have been definitely located on satellite imagery and correlated with aerial photos. Crops on these areas and surrounding areas have been determined by ground surveys. This information has been used in attempts to predict crops on unsurveyed areas which have corresponding color shades to those of the surveyed areas. Computer densitometer printouts are currently being used in the development of crop "signatures" based on the density information of the imagery as determined from the scanning microdensitometer. This procedure involves comparisons of various stages of crop maturity for each MSS Band. Of the imagery received and analyzed to date, only the 1 October, 1972 imagery has been sufficiently clear to use in signature development. Results from the study of 1 October imagery have been promising.

MSS Channels 4, 5, 6 and 7 were scanned, and a corresponding density printout for each was analyzed. If density values appearing on each

transparency were divided into four groups, the following results were found to hold true for each channel. Water had the highest density value. Forest land occupied the next highest level. Cropland (mainly soybeans and cotton) had the third highest density level. Pasture and similar grassland had the lowest density value. Results of printout analyses by MSS Channels for Ames Plantation are given in Table I. Further refinement of scanning and printout techniques is expected to enable further differentiation of areas into types of crops on cropland and types of trees in forested areas.

Attempts to extend the results from one set of imagery to an unsurveyed, unrelated set of imagery has proven, at most, discouraging. Even attempts to apply the results from one set of imagery to a time-differentiated set of imagery of the same scene produces ambiguity because of haze and cloud cover. But being able to identify features in the same scene from known, specified test sites in that scene is an initial achievement.

A Mosaic of 4 X enlargements of satellite imagery showing both target sites and the area in between is currently being prepared. The Mosaic is being prepared from a series of photos developed from imagery taken 1 October, 1972 which is very clear and has very good detail. This Mosaic should aid in locating significant features in relation to areas which previously have been difficult to locate on full-scale imagery.

Current Progress. Considerable progress has been made on the image processing system previously described in the Data Analysis Plan and in the first Type II, Six-Month Progress Report for this research. Color correction circuits were designed and built for the real-time image

TABLE 1. Results of Computer Printout Analysis for 1 October 1972 Imagery of Ames Plantation

MSS Channel	Density Subrange	Land Use, Terrain Features, or Crops
	Density Range 140-190	
4	140-153	Pasture
4	154-169	Cropland
4	180-188	Forest
4	190	Water
	Density Range 150-240	
5	168-196	Cropland
5	218-238	Forest
5	240	Water
	Density Range 115-160	
6	115-133	Cropland
6	124-133	Pasture
6	133-144	Area Around House & Barn
6	144-157	Forest
6	159-160	Water
	Density Range 100-140	
7	105-120	Cropland
7	121-132	Forest
7	140	Water

analyzer. This unit with an 8-band density slicing capability has been used extensively in recent weeks by the other ERTS Investigators.

Work has been completed on a simple interactive language to manipulate digital images on the minicomputer attached to the image processing system. This language is a necessity if minicomputer software is to be made available to the other groups working with ERTS imagery. For example, to use the system one needs only to attach the camera and have knowledge of a few basic commands. With these commands the user can store in the computer the digital representation of the scene being viewed by the camera, take its two-dimensional fast Fourier transform, filter the transform, take the inverse transform, and display the results in a number of different modes.

This facility, when utilized more effectively by the ERTS Investigators, will increase the efficiency of data processing since the result of any particular operation can be obtained within a few minutes - a favorable comparison with the one-day turn-around time experienced in the bulk processing of data.

Next Reporting Period. Data processing efforts will continue in Phase III. Effort will concentrate on delineation of features using both bulk processing of image data and using the capabilities of the image processing system.

Conclusions. Significant finding are presented in Table I. These findings demonstrate the feasibility of delineating major terrain features, land uses, and crop species through computerized analyses. At present only those unsurveyed features in the same scene with known test sites can be delineated. Attempts to apply data from one scene to an unsurveyed, unrelated scene have not been successful.

For the findings presented in this report, channel 6 appears to give the most information for making feature separations. By enlarging satellite imagery and visually comparing this with high altitude aerial photographs and computer printouts, data registration of small terrain features and cropland areas on satellite imagery is greatly facilitated.